

## Curriculum Vitae

### Douglas L. Tucker

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**Born:** 6 March 1965 in Clearwater, Florida

**Education:** Ph.D., Astronomy, Yale University, 1994  
M.Phil., Astronomy, Yale University, 1989  
M.S., Astronomy, Yale University, 1988  
B.A., Physics, New College of USF, 1987

**Ph.D. Dissertation:** Title: An Observational Study of Galaxies and their Environment  
on Large Scales  
Advisor: Augustus Oemler, Jr.  
Importance: First results from the Las Campanas Redshift Survey

**Experience:** 1996 – present: Applications Physicist,  
Experimental Astrophysics Group,  
Fermi National Accelerator Laboratory  
1994 – 1996: Postdoctoral Researcher,  
Astrophysikalisches Institut Potsdam (Germany)  
1987 – 1994: Research Assistant, Yale University  
1988 – 1993: Teaching Assistant, Yale University  
1987: Research Assistant, New College of USF

**Research Interests:** Sloan Digital Sky Survey, Las Campanas Redshift Survey,  
Compact Groups of Galaxies, Loose Groups of Galaxies,  
Large Scale Structure of the Universe, Precision Stellar Photometry

**Academic Awards:** Sterling Prize Fellowship, Yale University, 1987 – 1988  
National Merit Scholarship, 1983 – 1987  
Florida Academic Scholarship, 1983 – 1987  
Selby Award, New College of USF, 1983 – 1987

**Professional Societies:** American Astronomical Society  
Astronomical Society of the Pacific

**Other:** Member of the Sloan Digital Sky Survey “Builders” List

## References

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- Allam S.S., **Tucker D.L.** 1998, “Compact Groups of Galaxies in the Las Campanas Redshift Survey,” *Bulletin of the American Astronomical Society*, 30, No. 4, (abstract — poster)
- Brinkmann J., Smith J.A., **Tucker D.L.**, et al. 1998, “Setting up the Sloan Digital Sky Survey Standard Star Network: The Hardware,” *Bulletin of the American Astronomical Society*, No. 4, (abstract — poster)
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- Tucker D.L.**, Smith J.A., Brinkmann J., et al. 1998, “Setting up the Sloan Digital Sky Survey Standard Star Network: The Software,” *Bulletin of the American Astronomical Society*, 30, No. 4, (abstract — poster)
- Tucker D.L.**, Hashimoto Y., Kirshner R.P., Landy S.D., Lin H., Oemler A., Schechter P.L., Shectman S.A. 1998, “Groups of Galaxies in the Las Campanas Redshift Survey,” in *Large Scale Structure: Tracks and Traces*, eds. V. Müller, S. Gottlöber, J.P. Mückel, and J. Wambsganz, (Singapore: World Scientific), p. 105
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- Allam S., **Tucker D.** 1999, "An Atlas of Compact Groups from the Las Campanas Redshift Survey," *Bulletin of the American Astronomical Society*, 31, No. 5, 1392 (abstract — poster)
- Lee B., **Tucker D.**, Annis J., Stoughton C., Yanny B., Acebo Y., Bahcall N., Böhringer H., Voges W., Ellman N., Infante L., Vogeley M. 1999, "Compact Groups of Galaxies in the SDSS Commissioning Data," *Bulletin of the American Astronomical Society*, 31, No. 5, 1392 (abstract — poster)
- Stoughton C., Kron R., **Tucker D.**, Smith A., Chen B., Neilsen E., Tolea A., Laubscher B. 1999, "Star Clusters in SDSS Filters," *Bulletin of the American Astronomical Society*, 31, No. 5, 1434 (abstract — poster)
- Tucker D.L.** 1999, "The View of the Universe from Redshift Surveys," in *Beyond the Desert '99: Accelerator, Non-Accelerator, and Space Approaches (Second International Conference on Physics beyond the Standard Model)*, eds. H.V. Klapdor-Kleingrothaus and I.V. Krisosheina, (Philadelphia: Institute of Physics Publishing), p. 1145 (invited review)
- Blanton M. R., Dalcanton J., Eisenstein D., et al. 2000, "The Luminosity Function of Galaxies from SDSS Commissioning Data," *Bulletin of the American Astronomical Society*, AAS Meeting 197, #27.03
- Lee B. C., **Tucker D. L.** 2000, "Compact Groups of Galaxies in the SDSS Commissioning Data," *Bulletin of the American Astronomical Society*, AAS Meeting 197, #13.03
- Smith J. A., **Tucker D. L.**, Chen B., et al. 2000, "The Sloan Digital Sky Survey Standard Star Network," *Bulletin of the American Astronomical Society*, AAS Meeting 197, #13.11
- Lamb D. Q., Lee B. C., **Tucker D. L.**, Vanden Berk D. E., Newman P., Krzesinski J., Kleinman A. N. 2001, "GRB010921, Optical Observations," *GRB Circular Network (GCN)*, #1125
- Lee B. C., **Tucker D. L.**, Allam S. S. 2001, Compact Groups of Galaxies in the SDSS Early Data Release *Bulletin of the American Astronomical Society*, AAS Meeting 199, #100.19
- Lee B. C., **Tucker D. L.**, Brinkmann J. 2001, "Compact Groups of Galaxies in the SDSS Commissioning Data," in *The New Era of Wide Field Astronomy*, ASP Conference Series, Vol. 232., eds. R. Clowes, A. Adamson, and G. Bromage, (San Francisco: Astronomical Society of the Pacific), p.13
- Lee B. C., **Tucker D. L.**, Lamb D. Q., Vanden Berk D. E., Neilsen E. 2001, "GRB011130 (XRF011130) SDSS PT I-band observations," *GRB Circular Network (GCN)*, #1175
- Lee B. C., **Tucker D. L.**, Vanden Berk, et al. 2001, "Sloan Digital Sky Survey Multicolor Observations of GRB010222," *Bulletin of the American Astronomical Society*, AAS Meeting 198, #38.13
- Tucker D. L.**, Smith J. A., & Brinkmann J. 2001, "The Sloan Digital Sky Survey Standard Star Network," in *The New Era of Wide Field Astronomy*, ASP Conference Series, Vol. 232., eds. R. Clowes, A. Adamson, and G. Bromage, (San Francisco: Astronomical Society of the Pacific), p.170



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### **Seminar & Colloquium Talks**

Astronomical Institute of the Romanian Academy, in Bucharest, Romania, June 1990.

Union College, in Schenectady, New York, April 1994.

Space Telescope Science Institute, in Baltimore, Maryland, April 1994.

Universität Göttingen, in Göttingen, Germany, May 1995.

University of Durham, in Durham, England, October 1995.

Copenhagen University, in Copenhagen, Denmark, October 1995.

New College of USF, in Sarasota, Florida, January 1996.

Jagiellonian University, Krakow, Poland, March 1996.

Max-Planck-Institut für Astronomie, in Heidelberg, Germany, May 1996.

Osservatorio Astronomico di Capodimonte, in Naples, Italy, May 1996.

Istituto Nazionale di Fisica Nucleare/Sezione di Perugia, in Perugia, Italy, May 1996

Università Roma La Sapienza, in Rome, Italy, May 1996

New Mexico State University, in Las Cruces, New Mexico, February 1999

Tartu Observatory, in Toravere, Estonia, June 1999

Rochester Institute of Technology, in Rochester, New York, November 1999

## Teaching Goals and Philosophy

Astronomy enjoys a broad appeal. Furthermore, many of its modern discoveries are accessible to the intelligent layperson, which makes introductory astronomy courses popular to students of the humanities and social sciences. On the other hand, astronomy is a rigorous scientific discipline, of interest not only to those who choose astronomy as a career but also to science majors who desire a general knowledge of this branch of science. Therefore, astronomy serves as a bridge between the general public and the scientific community.

It is my desire to meet the needs of both the interested layperson and the career-oriented science major. Let us consider the needs of each in turn. First, the standard astronomical fare for the non-science major is a one- or two-semester general Introductory Astronomy course. This is indeed a tried-and-true method and is an important part of an astronomy course list, but I believe much more can be done. For instance, modern astrophysical discoveries could readily be incorporated into a “Modern Physics for Poets” course. Mathematically “soft” thematic, lab, and/or seminar courses are also a possibility. Regardless of the format, the aim of courses for non-science majors should be to teach the student the basics of astronomy and of scientific methodology. One acid test of success is that the student, after completing such a course, should be able to read a *Scientific American* article on the subject with a reasonable level of comprehension. Another test is that the student should be able afterwards to argue convincingly against the validity of various forms of “pseudo-science.”

On the other hand, the astronomy major requires — and the interested non-astronomy science major often desires — a rigorous program of mathematically intensive astrophysics. I would enjoy teaching a variety of courses for the science major. I would include among these a two-semester calculus-based sequence of Introductory Astronomy (using Shu or Abell as a primary text), an introductory or intermediate Observational Techniques course (using, among other texts, Henden & Kaitchuck), a semester- or year-long Stellar Physics course for sophomore- and junior-level students (with the Böhm-Vitense trilogy), a junior- or senior-level Cosmology course (Berry, Lachièze-Rey, Peebles, and/or others), and a junior- or senior-level Galaxies course (Mihalas & Binney; Combes, Boissé, Mazure, & Blanchard; Binney & Merrifield). The higher-level courses could also double as introductory graduate-level courses. To differing degrees, homework problem sets, student projects, and oral presentations would all play a part in each of these courses, with more emphasis being placed on projects and oral presentations in the upper-level courses. Outside of astronomy proper, I would also find teaching courses in Introductory Physics (Halliday & Resnick; Tipler), Statistics for Scientists and Engineers (Bevington), and Fortran Programming (various texts) of interest.

## Current and Future Research

Although my present position with the Sloan Digital Sky Survey contains a substantial service component (averaging about two-thirds service, one-third research), I have still been able to maintain a vigorous research program. Essentially all of my ongoing projects and future research plans involve either the Las Campanas Redshift Survey or the Sloan Digital Sky Survey. Let us consider each in turn.

### 1. The Las Campanas Redshift Survey (LCRS)

Most of my research over the past several years has centered on analysis of the LCRS (Shectman et al. 1996), a project which was first begun in the late-1980's by the team of Kirshner, Oemler, Schechter, and Shectman. (I joined the project as a graduate student in 1989.)

The LCRS is a survey of the galaxy distribution, out to a median redshift of  $z_{\text{med}} \approx 0.1$ , composed of six  $1.5^\circ \times 80^\circ$  slices — three towards the North Galactic Cap and three towards the South. The original goals of the LCRS were to sample a large enough volume of the nearby Universe in order to constrain the scale of the largest features in the galaxy distribution and to use this sample for the accurate measure of galaxy clustering on a wide variety of scales. In the end, redshifts for  $\sim 26,400$  galaxies were obtained, still one of the largest galaxy redshift catalogues ever compiled. Perhaps the most important result from the LCRS is the visually striking evidence that the scale of homogeneity had at last been reached: the largest high-contrast coherent structures apparent in the slices are no larger than about  $100h^{-1}$  Mpc across ( $h \equiv H_0/100 \text{ km s}^{-1} \text{ Mpc}^{-1}$ ), even though much larger features — had they existed — would have been easily identifiable.

#### 1.1. Large-Scale Structure in the LCRS

I have investigated several aspects of the large-scale structure within the LCRS, including the spatial autocorrelation function of galaxies (Tucker et al. 1997) and of loose groups of galaxies (Tucker 1994) and the dependence of galaxy type on environmental factors (Tucker et al. 1995). In collaboration with Andrei Doroshkevich of the Theoretical Astrophysics Centre (Denmark) and Dick Fong of the University of Durham (England), I have studied the mean free path between void walls ( $\sim 80h^{-1}$  Mpc) and between filamentary structures ( $\sim 15h^{-1}$  Mpc) (Doroshkevich et al. 1996). Doroshkevich, Fong, and I are presently looking into the three-dimensional properties of overdense regions within the LCRS (Doroshkevich et al. 2001). In another collaboration, Jaan and Maret Einasto of Tartu Observatory (Estonia) and I are in the process of extracting superclusters from the LCRS slices to study their clustering properties (Einasto et al. 2001). It is expected from our previous work (Einasto et al. 1997) that there is a  $120h^{-1}$  Mpc quasi-periodicity in the distribution of rich superclusters; some evidence of such a periodicity is hinted at in my examination of the LCRS galaxy autocorrelation function on large scales (Tucker et al. 1997, Tucker et al. 1998).

#### 1.2. Loose Groups of Galaxies in the LCRS

Loose groups are intermediate in scale and environment between isolated galaxies and rich clusters, and thus they are interesting in the study of morphology-environment relations.

I have extracted a catalogue of 1495 loose groups from the LCRS (Tucker et al. 2000). This is one of the largest loose group catalogues in existence. Furthermore, since the LCRS is one of the first redshift surveys which can claim to enclose a reasonably fair sample of the nearby Universe, my loose group catalogue should contain a “fair sample” of loose groups which lie in a wide range of environments. (Most previous group catalogues have been based upon much shallower redshift surveys which are dominated by a very few large structures.) A census of

group properties based upon LCRS groups is thus more complete, and therefore more useful for studies of both galaxy dynamics and environmental dependencies. In fact, this characteristic is so important that earlier variations of the present catalogue have already been used in studies of the environmental influence on galaxy morphology (Hashimoto et al. 1998), on the presence of “E+A” galaxies (Zabludoff et al. 1996), and on the general rate of star formation within galaxies (Hashimoto et al. 1998, Allam et al. 1999).

### 1.3. Compact Groups of Galaxies in the LCRS

Compact groups of galaxies are defined by their small number of members ( $< 10$ ), their compactness (typical intra-group separations of a galaxy diameter or less), and their relative isolation (intra-group separations  $\ll$  group-field separations); Stephan’s Quintet is a beautiful and noteworthy example. They offer an exceptional laboratory for the study of dense galaxian environments with short ( $\leq 1$  Gyr) dynamical timescales.

I have extracted 76 compact groups from the LCRS, and, in collaboration with Sahar Allam of Helwan Observatory (Egypt), I have studied the optical properties of these systems and the star formation properties of their member galaxies (Allam et al. 1999, Allam & Tucker 2000). I have also formed a collaboration — Hans Böhringer and Wolfgang Voges of the Max-Planck-Institut für Extraterrestrische Physik along with Sahar Allam — to study the x-ray properties of these compact groups. Interesting results from these studies include: (1) compact group galaxies show a deficit of star formation activity relative to loose group galaxies and to field galaxies, and (2) there is clear evidence of extended x-ray emission from hot gas from a significant fraction of LCRS compact groups. A preliminary collaboration among Marcus Price of the Australia Telescope National Facility, Sahar Allam, and myself into the radio observations of these compact groups has yet to yield results. Future studies will likely include further x-ray observations using Chandra and/or XMM and far-infrared observations using SIRTf and/or SOFIA.

## 2. The Sloan Digital Sky Survey (SDSS)

The SDSS, which began in earnest in early-2000, will eventually image one-quarter of the entire sky in 5 filters ( $u'g'r'i'z'$ ) down to a limiting magnitude of  $r_{\text{lim}} = 23.15$ . Within this bonanza of data will be photometry for  $\sim 10^8$  stars, galaxies, and quasars. Followup spectroscopy will eventually yield spectra for  $\sim 10^6$  galaxies and  $\sim 10^5$  quasars.

I have been deeply involved with the SDSS for the past four years, and a large portion of my future research will revolve around this enormous data set.

### 2.1. Compact Groups of Galaxies in the SDSS

I am presently mentoring Brian Lee, a postdoctoral researcher in the Experimental Astrophysics Group at Fermilab, in extracting a catalogue of compact groups of galaxies from the SDSS commissioning data. Eventually, we hope to extract  $\sim 10,000$  compact groups from the full SDSS photometric catalogue; the resulting catalogue should be roughly volume-limited and have a median redshift of  $z_{\text{med}} \sim 0.1$ . Thus, this catalogue will eventually be three times deeper and contain perhaps 100 times more compact groups than the venerable Hickson Compact Group catalogue. The SDSS compact group catalogue will be useful for studies of large-scale structure and of morphology-environment relations.

### 2.2. The SDSS Standard Star Network

Most of my work on the SDSS has dealt with the trio of support telescopes used by the SDSS for setting up the  $u'g'r'i'z'$  standard star network (the USNO 1m at Flagstaff), for monitoring nightly extinction (the now-retired 0.6m Monitor Telescope at Apache Point Observatory and the

new 0.5m Photometric Telescope which replaced it), and for obtaining a set of  $\sim 1500$  transfer fields to calibrate the photometry from the SDSS 2.5m telescope (the Photometric Telescope). .

As a result of my efforts, I will be a major contributing author on the paper describing the network SDSS standard stars (Smith et al. 2001). Furthermore, in an independent project, J. Allyn Smith of the University of Wyoming and I are pursuing together a project to extend the SDSS standard star network into the southern hemisphere; this project, which has been granted “Survey Program” status by NOAO, will greatly aid such projects as VISTA, a planned British survey telescope for the Southern Hemisphere which intends to use SDSS filters.

### 2.3. Star Clusters in the SDSS

Due in part to my experience with reducing small-telescope data with SDSS software, I have been invited to help out in a project to calibrate metallicity and age effects within stellar populations in the SDSS  $u'g'r'i'z'$  filter system. To this end, several classic star clusters which cover a range in both age and metallicity have been observed with the CTIO Curtis-Schmidt telescope by one of the other collaborators in this project (J. Allyn Smith); these observations will be reduced through the SDSS support telescope pipeline, MTPIPE. These data will thus act as accurate input for the re-calibration of standard models of our Galaxy (e.g., the Bahcall-Soneira model).

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